

Using XML-based Format in Wireless Spatial Databases

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ABSTRACT:

Nowadays, sharing the huge amount of geo-data is the main GIServices challenge. However, the new generation of handheld devices together with the growth of wireless web network, provide a suitable platform for GIS to share the geo-services. The devices suffer from small screen size, limited input and output capability and limited memory. Moreover, users look for spatial information services that are currently rare in the devices.

From one hand, wireless spatial services have to overcome wireless network and devices pitfalls, and on the other hand, they must introduce a system, in which, data transmission is fast and reliable and independent from platform regarding to diversity of devices.

In addition to application itself, the data play a prominent role in this scenario. It is vital to generate and transmit low volume and simple data, especially when system is dealing with vector data.

XML technology presents a simple and platform independent format to encode spatial data and any programming language is able to parse XML documents.

This paper elaborates on the powerful aspects of XML format and its advantages in wireless database managing applications. A case study has been developed to a wireless spatial service in which, client/server architecture is developed. In this model client is a wireless device and sends requests to the server. Server generates XML document from desired area, according to the request. Generated XML carries the spatial data and attributes to the device. A Java code in client side interprets the XML content and displays the result.

1. INTRODUCTION

Nowadays, with the rapid growing in amount of the geo-data, the major problem ahead of the SDSSs (Spatial Decision Support Systems) is not the availability or generating the data anymore. The most crucial problem is updating and sharing the huge amount of the geo-data, which must be addressed.

To solve the problems, GISs spread their services in ubiquitous environments. The most recent attempt of GIS researchers is to share the geo-data and geo-services in wireless environment.

The wireless devices expand from a cell phone to a powerful PC; hence, the software components of the system must be compatible with the diversity of the hardware, platforms and operating systems. One of the most important components of the wireless GIS is geo-data. Dealing with geo-data is different from other data contents. The geo-data is special because of handling spatial and aspatial data beside each other, and graphical presentation of spatial data. To deal with the diversity of the devices and geo-data characteristics, XML (eXtensible Markup Language) introduces an appropriate data format.

XML provides a platform independent meta-data. Modeling the data in XML, brings the characteristics of the XML to the data. Simplicity, openness, self description, and standardization are the most prominent advantages of XML over other data formats, especially in web-based systems. XML parsers are responsible for parsing the tags and contents of the XML document. XML schemas define an overall structure for the data. XSL provides a mechanism to map the XML data contents to the interested form.

This paper tries to investigate the shortcomings of the wireless handheld devices in dealing with geo-data, data transfer

obstacles in wireless environment, and a platform independent data format for diverse software/hardware. The paper eventually, introduces a practical method to overcome the obstacles of wireless GISs from geo-data viewpoint.

The case study, carried out in this paper, is put forward along to implement the geo-database part of a wireless GIS. The main database in server-side of the system converts the invoked instance of data to XML and sends back the XML document to the client, XML parser in the client-side parses the document using an application schema. The parsed contents are displayed in screen using an XSL (eXtensible Stylesheet Language).

2. WIRELESS GIS ARCHITECTURE

The wireless GIS architecture uses application logic type (thick-client) approach of client/server architecture. In this approach the main database resides in server-side and may consist of any traditional data formats (Figure 1). The server side application functions separately from client application. Server-side application is responsible for listening to the requests of user and generating XML documents from the main database. The client side application consist of three modules, GIS module comprising of GIS functions, XML parsing and interpreting module, and display module.

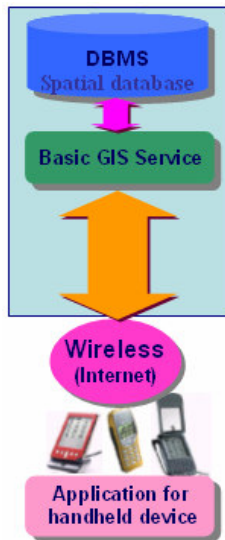


Figure 1. Wireless GIS Architecture

Every user request, invokes an instance of database corresponding to the desired function on data. Server application extracts the geo-data corresponding to the request from main database, converts the response to XML format and sends it back to the client (Figure 2) (Takino Shuichi, 2001).

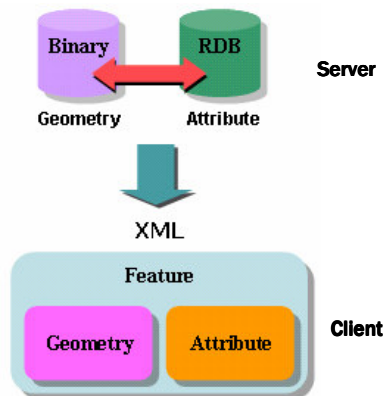


Figure 2. GIS Data Model

3. WIRELESS SPATIAL DATABASE: XML

Based on assessing different file formats, XML has been found as one of the most optimal variants for the GIS applications. It is optimal to provide to the user a rich set of functions and to use the wireless network minimally. XML possesses the following features:

- Interpretation in a wide range of mobile devices;
- Alternative ways for information representation (text, voice);
- Expandability;
- Structure flexibility.

XML-technology meets the requirements for the format development. The logical structure of the XML-based language is easy for program processing (XML 1.0, W3C Recommendation, 1998). Software can interpret the content of an XML file in a more appropriate way for each device or easy conversion of the contents to any intermediate format. XML is already widely used in the Internet. Therefore, a new Mark-up

Language could be easily integrated in current WWW(World Wide web) services (Garmash, Artem, 2001).

XML is a universal format for describing any data. When XML is discussed as a meta-language, it means that in real world, computer systems and databases contain data in incompatible formats. One of the most time consuming challenges for developers has been to exchange data between such systems over the Internet. Converting the data to XML can greatly reduce this complexity and create data that can be read by different types of applications, and this leads to a platform-independent structure.

XML supplies structure to documents. Structure by itself imposes constraints. Even though, the structure may seem like a limitation that might prevent flexibility, in reality it encourages interoperability and lays a common framework for tools and other utilities to evolve (Bell J., Loton T., Allamaraju S., Dalton S., Brown S., Harbourne-Thomas A., Holm B., Kunnumpurath M. M., Li S., 2002).

Regarding to wireless environment and device limitations, XML provides a suitable data format to respond to the demands of the application developed for wireless environment.

4. IMPLEMENTATION PHASE

The application developed in this paper, uses a pocket PC as a client device. The pocket PC is equipped with a Java application; also it uses GSM (Global System for Mobile Communication) wireless modem and SIM (Subscriber Identity Module) as wireless modem.

Residing the application and functions on the client side move the burden of the system to the client, and client needs no more transaction with the server until invocation of another data or service, and this generates the thick client architecture. The execution of the application generates an interface for choosing the map (Figure 3).

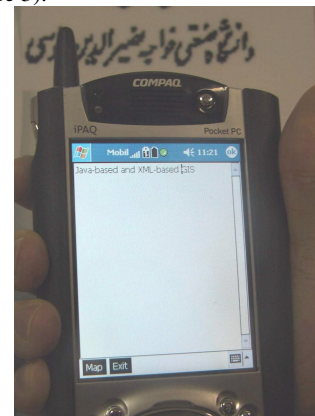


Figure 3. Execution of Application on Device Generates an Interface to Request the Map

Choosing the map option, sends a URL to the server side, the URL consists of the server's IP (Internet Provider), and the server-side application address.

The sent URL invokes the geo-data from the server, retrieves the interested geo-data and converts it to an XML document (Figure 4), and client-side application invokes the traverse function to parse the XML document.

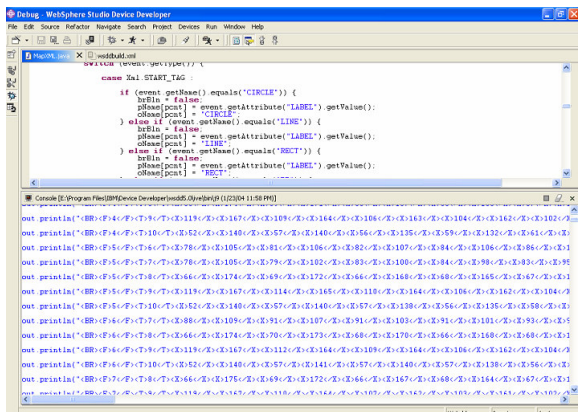


Figure 4. Server Sends the XML Document

The client uses Java-based parser to parse the document using a schema developed specifically for this application. The contents are extracted and display module uses an XSL to transform the contents to suitable display form (Mohammadi H., 2004). The new interface appears displaying the map and the tools such as zoom, pan, full extent and best route. Each number key on the mobile device sets the zoom to that number and the arrow keys pan the map (Figure 5).

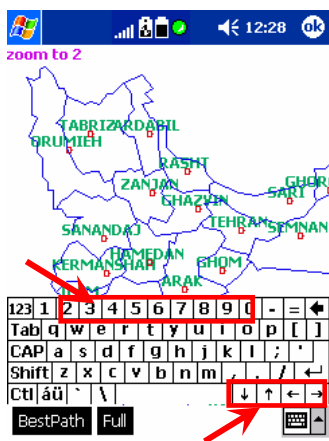


Figure 5. Zooming and Panning with keyboard

Best route option creates a new interface to select two begin and end cities and then the best route between two cities will be presented on the map (Figure 6).



Figure 6. Best Route Result (City of Ardebil to Esfahan)

5. CONCLUSIONS

The topic of this paper is one of the most important and considerable issue in GIS discipline. The paper focuses on geo-data component of wireless GIS. The major objectives of the research were to deal with data transfer and data interpretation in wireless GISs.

Many spatial data formats has been investigated and XML has been found as an appropriate Meta language to transfer and handle the data in Web and wireless environments. XML provides a text-based and platform independent structure for data.

As a conclusion web and wireless environments, regarding to their ubiquitous characteristics, makes more benefits for the users in contrast with stand-alone systems. More users, free or low price geo-data and GIS services and ubiquitous character of the systems are the most important advantages. These systems, in spite of the benefits, make more problems and challenges for the developers. Distributing and sharing the data and services, handling parallel requests, handling data in Internet environment must be addressed. Applying thick client architecture for client/server transaction and XML data format for transferring geo-data can help to solve these obstacles.

6. REFERENCES

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